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Network Architecture: lessons from the past, vision for the future

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The Architectural Principles of the Internet have dominated the past decade. Orthogonal to the telecommunications industry principles, they dramatically changed the networking landscape because they relied on iconoclastic ideas. First, the Internet end-to-end principle, which stipulates that the network should intervene minimally on the end-to-end traffic, pushing the complexity to the end-systems. Second, the ban of centralized functions: all the Internet techniques (routing, DNS, management) are based on distributed, decentralized mechanisms. Third, the absolute domination of connectionless (stateless) protocols (as with IP, HTTTP).

However, when facing new requirements: multimedia traffic, security, Grid applications, these principles appear sometimes as architectural barriers. Multimedia requires QoS guarantees, but stateless systems are not good at QoS. Security requires active, intelligent networks, but dumb routers or plain end-to-end mail systems are insufficient. Grid applications require middleware overlay networks, often with centralized functions.

Attempts to overcome these deficiencies may lead to excessively complicated hybrid solutions, distorting the initial principles (the QoS Pandora box). Middleware solutions are sometimes difficult to deploy (e.g for large scale PKI deployment). "Lambda on-demand"technologies are conceptually nothing else than old switched circuits, that we never managed to satisfactorily integrate with IP networks.

Where is all this going? To help forming a vision of the future, the paper will refer to several observations that the author has formulated over the past 30 years: the "breathing law"(a succession of decentralization and recentralization phases), the perpetual and oscillating mismatch of the bandwidth offer-demand, the conceptual antagonisms between resource level and complexity, between scaling and QoS.

Author: FLUCKIGER, F. (CERN)

Presenter: FLUCKIGER, F. (CERN)

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